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REPORT FOR CONSULTATION ON THE METROPOLITAN FARGO-MOORHEAD INTERSTATE AIR QUALITY CONTROL REGION (NORTH DAKOTA-MINNESOTA)

National Air Pollution Control Administration
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U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Environmental Health Service
National Air Pollution Control Administration

July 1970

NATIONAL TECHNICAL INFORMATION SERVICE

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PREFACE

The Clean Air Act, as amended, directs the Secretary of Health, Education, and Welfare to designate "air quality control regions" to provide a basis for the adoption of regional air quality standards and the implementation of those standards. The Act stipulates that the designation of a region shall be preceded by consultation with appropriate State and local authorities. This report is intended to provide the basic background information needed for the consultation. It proposes boundaries for the Metropolitan Fargo-Moorhead Interstate Air Quality Control Region and discusses the factors which are the basis of the proposed boundaries.

The Region* boundaries proposed in this report remain subject to revisions suggested during consultation with State and local authorities. Formal designation of the Region will be made only after a careful review of all opinions and suggestions submitted during the consultation process.

The National Air Pollution Control Administration appreciates assistance received from the States of North Dakota and Minnesota, and the local governments and planning agencies in the area.

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*For the purposes of this report, the word "region", when capitalized, will refer to the Metropolitan Fargo-Moorhead Interstate Air Quality Control Region.

INTRODUCTION

THE REGIONAL APPROACH

Air pollution in the urban areas of the United States is a regional problem which frequently extends across governmental boundaries. Since air pollution problems are rarely confined to any single municipality or county, and are often not confined within a single State, successful control requires coordinated planning, standard setting, and enforcement by the several political jurisdictions which share a common problem. To date, State and local governments across the Nation have only begun to develop a regional approach to air pollution control.

The Clean Air Act, as amended, provides a regional approach which depends upon coordination and cooperation among all levels of government--municipal, county, State, and Federal. To set in motion the machinery for regional air pollution control, the Department of Health, Education, and Welfare designates air quality control regions (following consultation with State and local officials), issues air quality criteria, and publishes reports on control techniques. The designation of region boundaries indicates which State and local jurisdictions will be involved in a regional air pollution control effort. The air quality criteria indicates the extent to which various concentrations of air pollutants are harmful to health and damaging to

property. The reports on control techniques provide information on the costs and effectiveness of various techniques for controlling air pollutant emissions.

After the Department of Health, Education, and Welfare completes these initial steps, State governments develop air quality standards and plans for implementation of such standards within the boundaries of designated air quality control regions. An air quality standard for a region defines the desired limit of concentration of a pollutant in its ambient air. It represents the level of air quality which the regional control program will attempt to achieve. An implementation plan is a blueprint of the steps which will be taken to attain chosen regional air quality standards within a reasonable time. The Clean Air Act requires that within 90 days after the Secretary of Health, Education, and Welfare has designated the region, State Governors must submit letters indicating that they intend to set air quality standards for those pollutants for which criteria and control technology documents have been issued. They have an additional 180 days to set the standards. The procedure for setting standards includes a public hearing which allows residents of a region to express their views concerning the proposed standards. The Governors are required to submit to the Secretary, within an additional 180 days, plans for the implementation of the standards which have been adopted.

The Department of Health, Education, and Welfare reviews air quality standards and implementation plans in order to ascertain their consistency with the provisions of the Act.

When air quality standards and implementation plans are approved, States proceed to prevent and control air pollution in accordance with those standards and plans. This system for establishing a regional approach to air pollution control is outlined in Figure 1.

DESIGNATION OF AIR QUALITY CONTROL REGIONS

Designation of an air quality control region is one of the first steps in the regional approach to air pollution control. Section 107 (a) (2) of the Clean Air Act, as amended, directs the Secretary, Department of Health, Education, and Welfare to make such designations. The portions of the section relevant to this discussion state:

> "...The Secretary, after consultation with appropriate State and local authorities shall...designate air quality control regions based on jurisdictional boundaries, urban-industrial concentrations, and other factors including atmospheric areas necessary to provide adequate implementation of air quality standards. The Secretary may...revise the designation of such regions...The Secretary shall immediately notify the Governor or Governors of the affected State or States of such designation."

Procedure for Designation of Regions

Figure 2 illustrates the procedures used by the National Air Pollution Control Administration (NAPCA) for designating air quality

HEW DESIGNATES AIR QUALITY CONTROL REGIONS.
HEW DEVELOPS AND PUBLISHES AIR QUALITY CRITERIA BASED ON SCIENTIFIC EVIDENCE OF AIR POLLUTION EFFECTS.
HEW PREPARES AND PUBLISHES REPORTS ON AVAILABLE CONTROL TECHNIQUES
90 DAYS
STATES INDICATE THEIR INTENT TO SET STANDARDS.
(PUBLIC HEARINGS)
180 DAYS
STATES SET AIR QUALITY STANDARDS FOR THE AIR QUALITY CONTROL REGIONS.
STATES SUBMIT STANDARDS FOR HEW REVIEW.
180 DAYS
STATES ESTABLISH COMPREHENSIVE PLANS FOR IMPLEMENTING AIR QUALITY STANDARDS.
STATES SUBMIT IMPLEMENTATION PLANS FOR HEW REVIEW.
STATES ACT TO CONTROL AIR POLLUTION IN ACCORDANCE WITH AIR QUALITY STANDARDS AND PLANS FOR IMPLEMENTATION.

FIGURE 1 - Flow Diagram for Action to Control Air Pollution on a Regional Basis, under the Air Quality Act.

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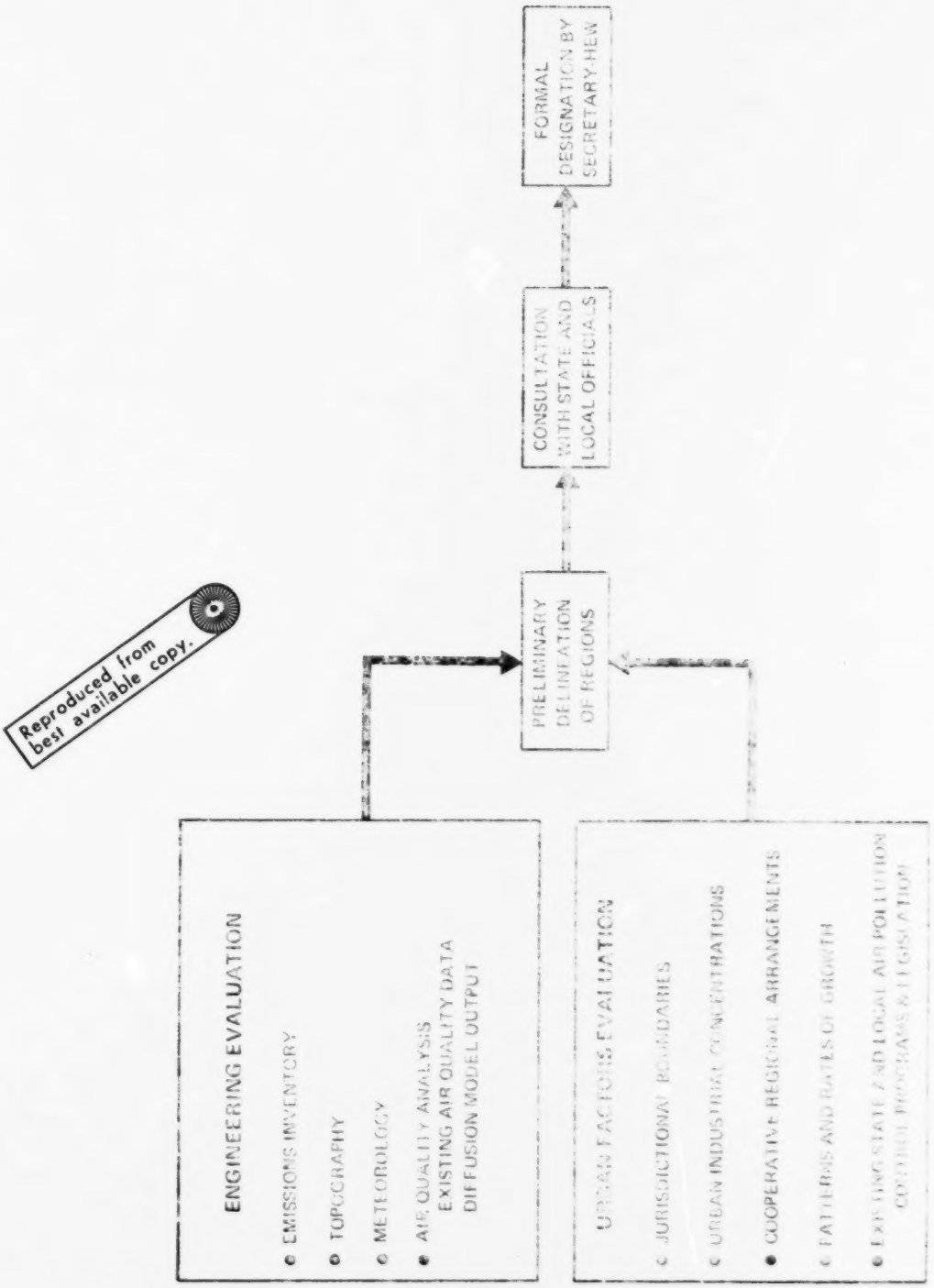

FIGURE 2 - Flow Diagram for the Designation of Air Quality Control Regions

control regions.

After evaluating relevant technical and urban factors in a region, the National Air Pollution Control Administration publishes a proposed delineation of its boundaries. At the same time, NAPCA sets a time and place for a consultation meeting and distributes to State and local authorities a report of the evaluation study (such as this "Report for Consultation") which includes the boundary proposal. At the consultation meeting State and local authorities are encouraged to present fully their views and suggestions concerning the proposed boundaries of the region. Interested parties who do not have official status may submit comments in written form for the record. After careful review of all suggestions and opinions submitted for the record by interested parties, the Secretary of Health, Education, and Welfare makes a formal designation of the region boundaries and notifies the Governor(s) of the State(s) affected by the designation.

The Size of a Region

As stipulated in Section 107 (a) (2), the designation of air quality control regions should be based on "jurisdictional boundaries, urban-industrial concentrations and other factors including atmospheric areas necessary to provide adequate implementation of air quality standards." This language suggests a number of objectives which are important in determining how

large an air quality control region should be. Basically, these objectives can be divided into three separate categories.

First, a region should be self-contained with respect to air pollution sources and receptors. Unfortunately, since air pollutants can travel long distances, it is impractical if not impossible to delineate regions which are completely self-contained. The air over a region will usually have at least trace amounts of pollutants from external sources. During episodic conditions, such contributions from external sources may even reach significant levels. Conversely, air pollution generated within a region and transported out of it can affect external receptors to some degree. It would be impractical and inefficient to make all air quality control regions large enough to encompass these low-level trace effects. The geographic extent of trace effects overestimates the true problem area which should be the focus of air pollution control efforts. Thus, the first objective, that a region be self-contained, becomes a question of relative magnitude and frequency. The dividing line between "important influence" and "trace effect" will be a matter of judgment. The judgment should be based on estimates of the impact a source has upon a region, and the level of pollution to which receptors are subjected. In this respect, annual and seasonal data on pollutant emissions and ambient air concentrations are a better measure of relative

influence than short term data on episodic conditions. In summary, a region should include most of the important sources in the area as well as most of the people and property affected by those sources.

The second general objective requires that regional boundaries be designed to meet not only present conditions but also future conditions. In other words, the region should include areas where industrial and residential expansion are likely to create air pollution problems in the foreseeable future. This objective requires careful consideration of existing metropolitan development plans, expected population growth, and projected industrial expansion. Such considerations should result in the designation of regions which will contain the sources and receptors of regional air pollution for a number of years to come. Of course, regional boundaries need not be permanently fixed, once designated. Boundaries should be reviewed periodically and altered when changing conditions warrant readjustment.

The third objective is that regional boundaries should be compatible with and even foster unified and cooperative governmental administration of the air resource throughout the region. Because air pollution usually extends across governmental boundaries, the cooperation of several governmental bodies is required for the solution of a common set of air pollution problems. In this regard, the established patterns of governmental coopera-

tion on a range of urban problems is an important consideration, and the pattern of cooperation among existing air pollution control programs is a particularly relevant factor. In general, administrative considerations would argue against the division of governmental jurisdictions. Although it would be impractical to preserve State jurisdictions undivided, usually it is possible to preserve the unity of county governments by including or excluding them in their entirety. Occasionally, even this would be impractical due to a county's large size, wide variation in level of development, or striking topographical features.

To the extent that any two of the above three objectives lead to incompatible conclusions concerning region boundaries, the region must represent a reasonable compromise. A region should represent the best way of satisfying the three objectives simultaneously.

As noted above, the evaluations of relevant technical, urban, and governmental factors form the basis of the boundary proposals published by NAPCA. The technical factors study takes account of the location of pollution sources and the geographic extent of serious pollutant concentrations in the ambient air. Pollution sources are identified through an inventory of emissions from power generation, industrial operations, space heating, waste disposal, and other pollution-causing activities. The transport and distribution of pollutants in the ambient air are

analyzed on the basis of measured air quality data, the location of emissions, meteorological data, and topographic information. A mathematical diffusion model which predicts ambient pollution concentrations from information on emissions and meteorology can be used in areas where irregular topographical features would not invalidate the theoretical model. As a whole, the technical factors study indicates how large the air quality control region should be in order to encompass most pollution sources and most people and property affected by those sources.

The study of urban factors takes account of a different set of considerations. It discusses the location of urban and industrial concentrations and expected patterns of urban growth. As a whole, the urban factors study indicates how large a region should be in order to encompass expected regional growth.

The evaluation of the regional governmental organizations discusses the planning agencies, councils of government, and state and local air pollution control programs. This study attempts to define the combination of counties which, through cooperative regional arrangements, would best work together towards achieving clean air in the region.

The body of this report contains a proposal for the boundaries of the Metropolitan Fargo-Moorhead Interstate Air Quality Control Region following evaluation of technical, urban, and governmental factors. The report is intended to

serve as the background document for the formal Consultation between the National Air Pollution Control Administration and the appropriate State and local authorities.

EVALUATION OF URBAN FACTORS

The extent, nature, and prospective growth of a region's urbanization are important considerations in determining boundaries for its air quality control region. In this discussion of the Metropolitan Fargo-Moorhead area, major geographic and resource characteristics of the area and their effects on past development will first be noted. The area's present population distribution and economic activity pattern will then be described. Finally, factors likely to have a bearing on the area's future urbanization and available estimates of its scale and direction will be summarized.

GEOGRAPHY AND PAST DEVELOPMENT OF REGION

The Metropolitan Fargo-Moorhead area selected for study consists of Cass County in eastern North Dakota and adjoining Clay County in western Minnesota. The cities of Fargo in Cass County and Moorhead in Clay County are near the center of the two-county area and located on opposite banks of the Red River of the North (Figure 3). The River, which begins at the confluence of the Bois de Sioux and Otter Tail Rivers some 50 miles south of Fargo-Moorhead, flows north for about 530 miles into Lake Winnipeg in Canada. It forms the boundary between the States of North Dakota and Minnesota as well as the border between the two counties of the study area.

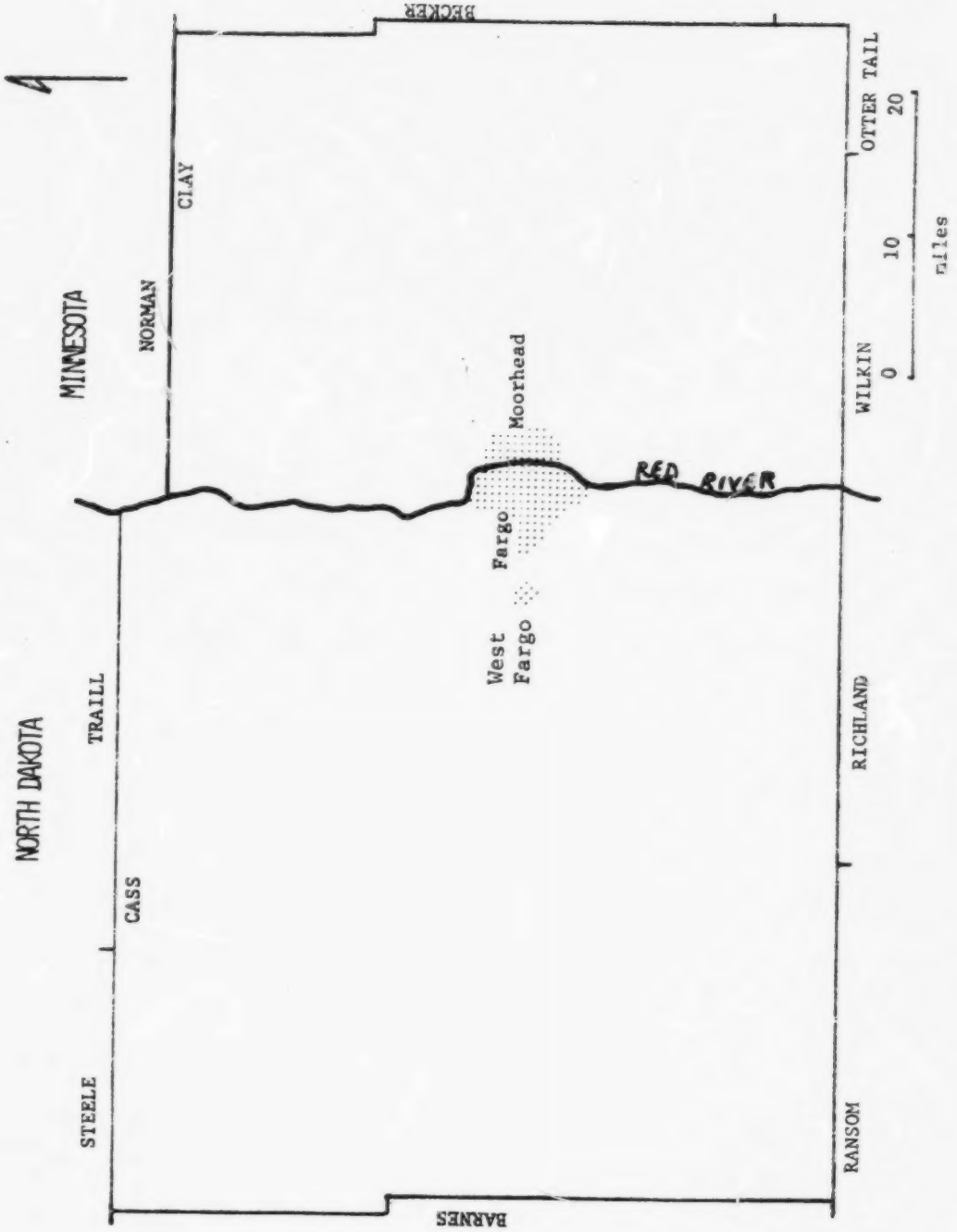

FIGURE 3 - Metropolitan Fargo-Moorhead Study Area

In the heart of the study area is a portion of the Red River Valley, a flat, treeless, stone-free terrain. Once the bed of a glacial lake, the Valley soils are black, deep, and rich in organic matter. Average land elevations in the Valley are somewhat less than 900 feet above sea level in Cass County and somewhat higher in Clay County. Because of its terrain and soil characteristics, the Valley area has drainage problems and is subject to severe flooding. Beyond the Valley in both counties, the flat land gives way to rolling country and gradually rising elevations to a maximum of about 1200 feet. Easternmost Clay County is at the edge of one of Minnesota's many lake areas.

Although the Red River was a transportation route for fur trading from early in the 18th century and steamboat service began in 1859, settlement in the study area did not take place until railroad construction crews arrived in the 1870's to bridge the River. Both the Northern Pacific and Great Northern chose Fargo-Moorhead as the crossing point from Minnesota into North Dakota. Moorhead, established in 1871, and Fargo, in 1875, began as huts and shelters for construction crews, but became service and trading centers for farmers whose numbers were swelled by a major wave of immigration from Scandinavia and Northern Europe. A powerful stimulus for immigration and settlement was provided by the railroads in this period when they transformed their land grant areas into huge "bonanza" farms, ranging in size from 3,000

to 65,000 acres, and succeeded in demonstrating that huge wheat yields could be obtained. As farming prospered, the cities of Fargo and Moorhead grew. By 1890, Fargo had a population of about 5,500, and Moorhead, another 2,000.

By the 1920's, a steady expansion of farm settlement had developed a considerable demand for farm equipment as well as a range of consumers goods. The demand became dispersed over the extensive Red River Valley and throughout North Dakota. Fargo-Moorhead, at the rail transportation gateway to the market, became a wholesale distribution center for the broad region (Figure 4). Bulk shipments of farm implements, for example, came in by rail to Fargo-Moorhead for subsequent redistribution to country retail outlets. At the same time, processing industries like feed preparation and meat packing, based on the return flow of agricultural produce, were established in the study area. However, lack of other raw materials, the limited size of the regional market, and its dispersion, inhibited further industrial diversification in Fargo-Moorhead.

The Great Depression of the 1930's and the collapse of the nationwide agricultural market initiated an exodus from farming in the region. The outward movement continued as a result of increasing farm mechanization, consolidation of farms into larger units, and Federal Government crop and acreage restriction policies. While Fargo-Moorhead was able to absorb some of the

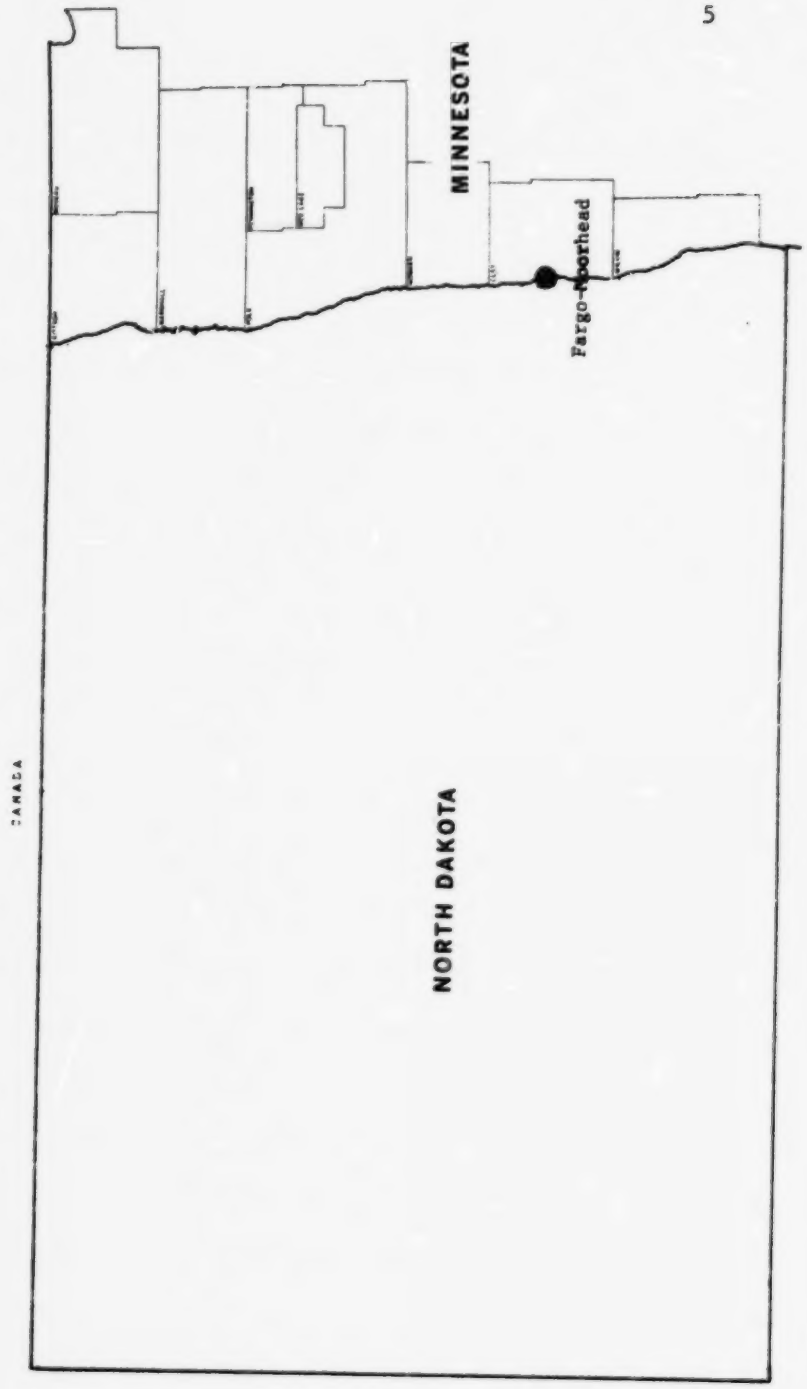

FIGURE 4 - Fargo-Moorhead Wholesale Marketing Area

population leaving farms into urban activities, most of the outflow constituted an attrition of the urban area's market base.

In the past two decades, Fargo-Moorhead has received secondary benefits from nonfarm activities outside the study area. Among these are crude petroleum and gas production and coal mining in the western counties of North Dakota; major water reservoir and interstate highway construction in the State; and the installation of two Strategic Air Force bases.

PRESENT POPULATION AND ECONOMIC ACTIVITY PATTERN OF THE STUDY AREA

Preliminary U. S. Census Bureau tabulations of the 1970 decennial census of population indicate that the present population of the study area is 118,184, of whom 72,710 are in Cass County and 45,474 in Clay County (Table I). About 86,800 people, nearly three-fourths of the total in the area, are concentrated in the cities of Fargo, nearby West Fargo, and Moorhead. As a consequence, these urban areas have average population densities per square mile ranging from West Fargo's 3,395 to Fargo's 4,623, while the extensive rural portions of Cass and Clay Counties have average densities of 9 and 15 persons per square mile, respectively.

A general over-view of the area's economic profile can be obtained by examining its major sources of personal income, and by comparing its income characteristics with those of all metropolitan counties in the United States. This comparative analysis

Table I

Population and Population Densities, Metropolitan Fargo-Moorhead Study Area, 1970

	Population	Land Area (square miles)	Population per square mile
Metropolitan Fargo-Moorhead Study Area (Cass and Clay Counties)	118,184	2,794.0	42
Cass County, N. D.	72,710	1,749.0	42
City of Fargo	52,697	11.4	4,623
City of West Fargo	5,093	1.5	3,395
Rural Cass County	14,920	1,736.1	9
Clay County, Minnesota	45,474	1,045.0	44
City of Moorhead	29,026	6.5	4,445
Rural Clay County	16,048	1,038.5	15

Sources: Population--U. S. Bureau of the Census, published and and unpublished preliminary results of April 1, 1970, tabulation; land area--for counties, U. S. Bureau of the Census, City and County Data Book, 1967, and for cities, information obtained from city officials.

for the years 1950 and 1967 is shown in Table II.

The first significant aspect to be noted of the study area's economy is its continuing high dependence on farm earnings. While a very substantial decline in this category of earnings in the study area's total income took place between 1950 to 1967--from 19.3 percent to 8.0 percent--the latter ratio is still very high compared to the 1967 ratio of 0.8 percent for all U. S. metropolitan areas.

Second, manufacturing plays a markedly smaller role in the study area's economy than in U. S. metropolitan counties as a whole. The comparative ratios in 1967 are 5.3 percent and 24.4 percent, respectively.

Third, the service activities of contract construction; transportation, communications, and public utilities; wholesale and retail trade; and finance, insurance, and real estate are of greater importance as sources of income in the study area than in metropolitan counties generally.

Fourth, the share of state and local government earnings in the study area's total income increased faster between the two periods than in U. S. metropolitan counties generally.

The income data appear to indicate that, with the exception of farming, the study area's activities are mainly those which derive from the needs of the local and regional market. The same picture emerges from an examination of the distribution of

Table II

Comparison of Economic Profile of Fargo-Moorhead Study Area with All U.S. Metropolitan Counties, 1950 and 1967

	Percent of Total Personal Income			
	Fargo-Moorhead Study Area		All U.S. Metropolitan Counties	
	1950	1967	1950	1967
Total personal income	100.0	100.0	100.0	100.0
Property income	10.3	18.1	12.8	14.5
Transfer payments less personal contributions for social insurance	4.4	4.2	4.8	4.2
Total earnings	85.3	77.7	82.5	81.2
Farm earnings	19.3	8.0	2.1	0.8
Total nonfarm earnings	66.0	69.7	80.4	80.4
Government earnings	7.5	12.5	9.3	12.7
Total Federal	3.1	2.9	5.2	5.7
Federal civilian	2.7	2.3	3.3	3.6
Military	0.4	0.6	1.9	2.1
State and local	4.4	9.6	4.1	7.0
Private nonfarm earnings	58.5	57.2	71.1	67.7
Manufacturing	6.1	5.3	26.5	24.4
Mining	1/	1/	1.0	0.5
Contract construction	8.1	7.0	5.3	5.0
Transportation, communications, and public utilities	10.2	7.8	7.3	6.1
Wholesale and retail trade	22.2	19.3	16.5	14.1
Finance, insurance, and real estate	3.8	5.3	4.2	4.8
Services	7.8	12.2	10.0	12.2
Other	1/	1/	0.2	0.2

Source: Unpublished data obtained from the U.S. Department of Commerce, Office of Business Economics

1/ Omitted to avoid disclosure of data for individual reporting units; data included in totals.

employment (Table III). In 1969, more than half of the study area's total average nonagricultural employment of 40,600 was accounted for by trade, government, and miscellaneous services. On the other hand, manufacturing was a relatively minor source of employment. In April, 1970, manufacturing employment had declined to 2,600 from an average of 2,900 in 1969, although this may be in part due to seasonal and temporary factors.

Current information on firms engaged in manufacturing in the study area is available from recent manufacturing directories for North Dakota and Minnesota. From an analysis of this information, meat packing, miscellaneous food products manufacturing, sugar refining, feed preparation, printing and publishing, fabricated metal products manufacture, machinery production, and machine shop work appear to be among the more important categories. However, a large majority of the establishments in these industries are small, most of them employing fewer than 25 persons. Among the larger establishments are a meat packing plant in West Fargo, a sugar refinery in Moorhead, and a gray iron foundry and metal products fabrication plant in Fargo.

One feature of this discussion is the fact that the area has a relatively small number of industrial processes which contribute heavily to air pollution. Apart from the sugar factory and the gray iron foundry mentioned above, the most important source points are a number of small feed mills

Table III

Nonagricultural Employment, Metropolitan Fargo-Moorhead Study Area, 1967-70
(thousands)

	1967	1968	1969	April 1970[b/]
Total	36.9	39.1	40.6	41.7
Contract construction	2.5	2.6	2.9	2.6
Manufacturing	2.6	2.8	2.9	2.6
Transportation and public utilities	3.1	3.1	3.2	3.2
Wholesale and retail trade [a/]	11.4	12.1	12.2	12.4
Finance, insurance and real estate	2.2	2.2	2.3	2.3
Services and mining	7.1	7.7	8.1	8.9
Government	7.9	8.5	9.0	9.6

Source: U. S. Department of Labor, Employment and Earnings.

a/ No breakdown recorded between wholesale and retail trade. However, U. S. Bureau of the Census figures in County Business Patterns, 1967, indicate that wholesale trade employment in 1967 was 37 percent of all employment in trade.

b/ Not adjusted for seasonal variations.

located both in the built-up urban areas and in the rural portion of the study area. A small asphalt products plant is also located in West Fargo.

Although two small electric generating stations are located in the study area, most of the area's power needs are supplied from generating facilities elsewhere through long-distance transmission lines and an extensive set of regional power pooling arrangements.

PROSPECTIVE POPULATION AND ECONOMIC GROWTH

In considering future population growth in the study area, past growth trends provide a guide. However, in view of the area's close economic interdependence with the broader region of North Dakota and eastern Minnesota, population and economic prospects of the broader region are also relevant.

As Table IV shows, the study area's gain in population in the 1960-70 decade was 12,157, an increase of about 1.1 percent per year. The increase occurred despite a loss of population of 23,000 in the broader North Dakota-Minnesota region. However, it should be noted that the study area's gain in the decade was smaller than its gain in the previous 1950-60 decade. The larger 1950-60 increase coincided with a population increase of 12,000 in the broader region, all of it in the State of North Dakota. This would appear to indicate that although the study area population increases even when losses are suffered in the broader region, the rate of gain is lower than when the broader region (especially the North Dakota portion) is also expanding.

If the study area population in the 1970-80 decade increases by the same number of people as in the decade just past, its total in 1980 would be about 130,000. Should the increase be at the 1960-70 rate of growth of 1.1 percent per year, the area's 1980 population would be about 132,000. A higher estimate of

Table IV

Population Trends, Metropolitan Fargo-Moorhead Study Area, State of North Dakota, and Eastern Minnesota, 1930-70

	Metropolitan Fargo-Moorhead Study Area	State of North Dakota	Nine Eastern Minnesota Counties a/
		(thousands)	(thousands)
Population			
1930	71,855	681	140
1940	78,186	642	153
1950	89,240	620	150
1960	106,027	632	150
1970	118,184	611	148
Increase or Decrease in Population			
1930-40	+ 6,331	-39	+13
1940-50	+11,054	-22	- 3
1950-60	+16,787	+12	0
1960-70	+12,157	-21	- 2

Source: Published and preliminary unpublished data of U. S. Bureau of the Census.

a/ Includes Clay, Kittson, Marshall, Norman, Pennington, Polk, Red Lake, Roseau, and Wilkin Counties.

139,000 was made in a 1964 study for the Fargo-Moorhead-Dilworth-West Fargo Metropolitan Council of Governments and Planning Commission.[1/] On the other hand, the National Planning Association of Washington, D.C., estimated an annual growth rate for the area of 0.9 percent[2/]--a rate which would yield a 1980 population of only 127,000.

Among the factors which will have a bearing on the study area's rate of growth, farm prospects in the broader region which it serves are probably of greatest importance. In 1964, the Census of Agriculture showed that North Dakota was one of the most rural in the United States, having 93.3 percent of its land area in farms. The State is the leading producer of barley and flaxseed; the second largest producer of both wheat and rye; and in the top ten in sugar beet production. Cattle and dairy products are also major sources of cash receipts.

Table V shows that although the proportion of farm income in total income is generally declining, major losses in farm income have tended to be associated with lower per capita income from all sources. This was true, for example, in 1959, 1961, and 1964.

1/ Barton-Aschman Associates, Inc., Population, Housing, and Economics, Comprehensive Planning and Transportation Studies, Fargo-Moorhead Metropolitan Area, July, 1964.

2/ National Planning Association, Economic and Demographic Projections for States and Metropolitan Areas, Regional Economic Projections Series, Report No. 68-R-1, January, 1969.

Table V

Farm Income and Per Capita Total Income
in North Dakota, 1950-68

	Farm Income		Per Capita Personal Income
	Amount (millions of dollars)	Percent of Total Personal Income	(dollars)
1950	299	38	1,263
1951	284	36	1,315
1952	201	27	1,217
1953	199	26	1,243
1954	171	22	1,254
1955	243	29	1,379
1956	241	27	1,437
1957	208	23	1,479
1958	294	29	1,700
1959	147	15	1,537
1960	240	22	1,715
1961	97	10	1,504
1962	432	31	2,155
1963	292	23	2,002
1964	206	16	1,981
1965	345	23	2,307
1966	319	20	2,441
1967	271	17	2,527
1968	298	17	2,730

Source: Unpublished data obtained from the U. S. Department of Commerce, Office of Business Economics.

Note: Farm income consists of the net income of farm proprietors, farm wages, and farm "other labor" income.

In the period ahead, as in the past, farm income in the region will be subject to the uncertainties of weather, the market, and Federal Government crop support policies. Variations in farm income and purchasing power would in turn have an impact on the volume of economic activity in the study area.

North Dakota's 1968 income from mining was only $14 million compared to $298 million from farming. However, mining income has risen over the past decade. In the period ahead, expansion of crude oil and natural gas production appears unlikely but greater use of the State's vast lignite coal deposits is possible. Over 350,000,000 tons of lignite--the largest estimated recoverable coal reserves in the United States--are distributed at easily mined depths in 23 counties in the western half of the State. 3/ One "mine-mouth" electric power plant with a rated capacity of 234 megawatts is due to go on stream in 1970, and another of that type with a capacity of 400 megawatts is planned for 1975. Of significance for air quality control in the study area is the announced 1970 addition of a coal-burning 28 megawatt unit to the existing power station in Moorhead. 4/

3/ Federal Power Commission, West Central Region Power Survey, 1970-1990.

4/ National Coal Association, Steam-Electric Plant Factors, 1969.

Highway construction and the construction and operation of air defense installations at Minot and Grand Forks, North Dakota, have contributed substantially to payrolls and income in the State. At the present time, construction is underway on a $200 million Safeguard ABM installation at Grand Forks, 5/ and work on the north-south interstate highway, I-29, which passes through the study area, is continuing. Future income from Federal Government expenditures in these categories is dependent on national transportation and defense policies which may be subject to major shifts in emphasis.

One "industry" located in the study area but largely dependent on family incomes in other parts of North Dakota and Minnesota, is higher education. Two colleges and a university in the area now have an estimated total enrollment of about 13,000 students. Continued enrollment growth is expected together with attendant increases in construction activity as well as employment. However, neither substantial growth nor diversification of goods-producing industries is generally anticipated. Instead, gradual growth consistent with the study area's advantages as a regional trade and services center is both expected and sought, with emphasis on improvement of the area's urban and environmental qualities.

5/ Fargo, North Dakota, The Forum, May 22, 1970.

PROBABLE DIRECTIONS OF PHYSICAL GROWTH

In a 1966 study undertaken for the area's Council of Governments and Planning Commission, [6/] it was anticipated that long-term physical growth of the urban area would be mainly toward the south along both sides of the Red River and southward in West Fargo (Figure 5). Routing of the east-west Interstate expressway, I-94, through the southernmost part of the built-up area of Moorhead and Fargo lent force to this prediction. It may not, however, take sufficient account of the pull which will be exerted by the north-south Interstate highway, I-29, when it is completed over its entire route through South Dakota and North Dakota. This highway, running through the study area between Fargo and West Fargo, could cause a convergence of the two communities as trade and service establishments seek locations at main interchange points. Should this development take place, a westward rather than a southward growth of the urban area would occur.

6/ Barton-Aschman Associates, Comprehensive Land-Use and Transportation Plan, Fargo-Moorhead Metropolitan Area, July, 1966.

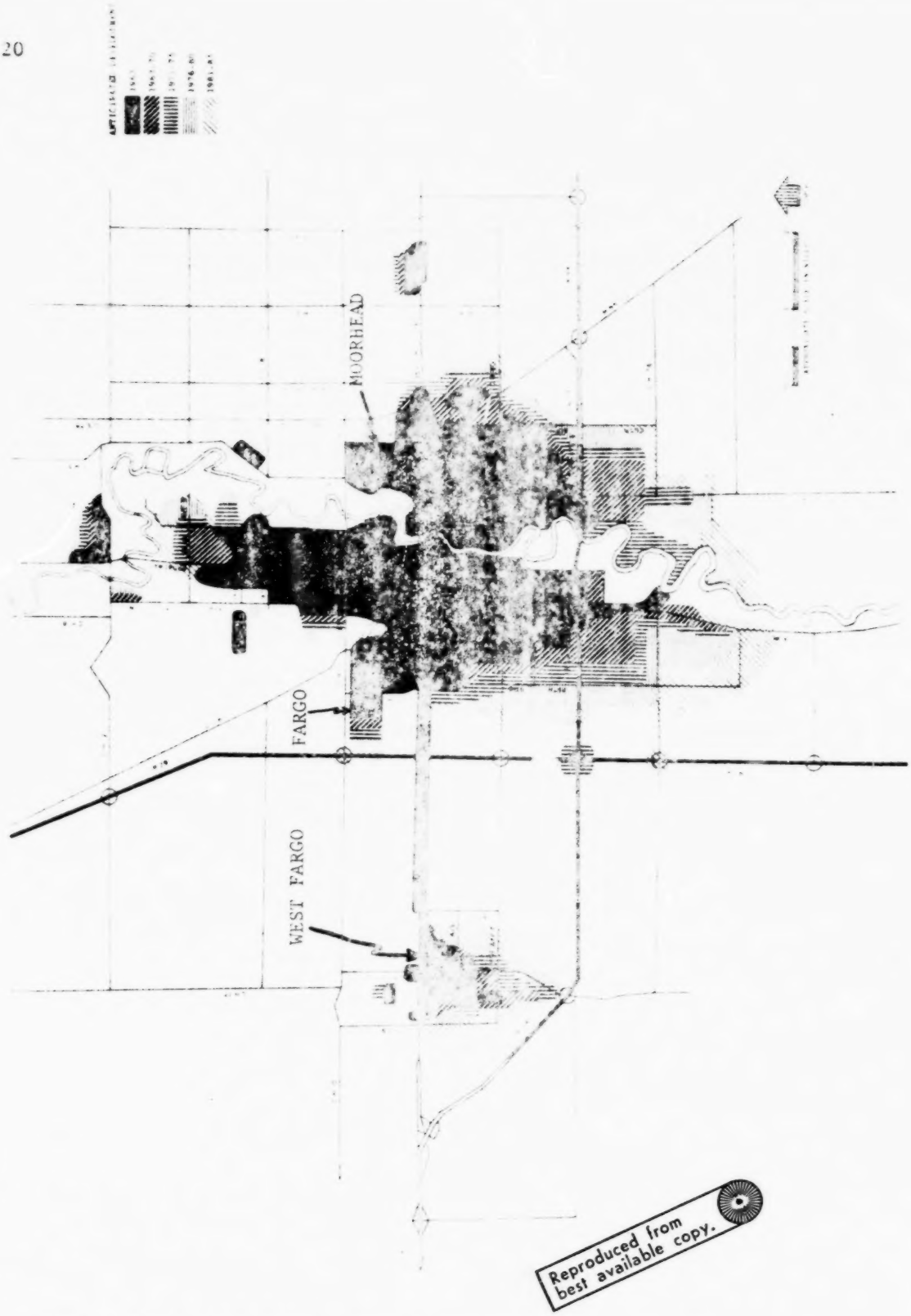

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FIGURE 5 - Anticipated Urban Growth Pattern, Metropolitan Fargo-Moorhead Study Area

EVALUATION OF TECHNICAL FACTORS

The technical factors of importance in considering the boundaries of an air quality control region are:

1. The total quantity of pollutants emitted;
2. the geographic pattern of emissions sources; and
3. patterns of pollutant dispersion.

By relating these technical factors to urban factors described above, it is possible to evaluate both pollution sources and people and property affected by these sources.

In the Fargo-Moorhead study area, information with respect to technical factors was obtained from an emission inventory conducted by the National Air Pollution Control Administration (NAPCA), air quality data provided by the North Dakota State Department of Health, and a theoretical diffusion model developed from the inventory data and meteorologic data.

THE EMISSION INVENTORY

The emission inventory, based on 1968 data, includes estimates from a two-county interstate area surrounding the cities of Fargo, North Dakota, and Moorhead, Minnesota (Cass County. North Dakota, and Clay County, Minnesota).

The NAPCA emission inventory is available as a separate publication.7/ Signficant findings are summarized here.

7/ U. S. Department of Health, Education and Welfare, Public Health Service, Environmental Health Service, National Air Pollution Control Administration, Durham, North Carolina, March 1970. Fargo-Moorhead Metropolitan Area Air Pollutant Emission Inventory Report.

Methodology

The quantity of emissions in the study area was estimated individually for point sources and areawide for other sources by use of a survey technique developed by the Public Health Service. 8/ Facilities which emit large quantities of pollutants were identified individually as point sources, while contributors such as motor vehicles, residential and commercial fuel users, small industries, and on-site refuse burning, were considered collectively as one source.

Emission estimates were obtained by applying average emission factors 9/ to indicators of pollutant emissions such as production data or type of fuel burned. Because these are average factors, estimates from a specific source may vary from actual emissions, but total estimates are likely to approximate actual conditions as the variances will average out.

Geographic distribution of the emissions was determined by dividing the study area into grid zones (Figure 6) and apportioning the estimated point and area source emissions to their respective grid zones (Table VI).

8/ Public Health Service, Rapid Survey Technique for Estimating Community Air Pollution Emissions. Publication No. 999-AP-29, Environmental Health Series, U.S.D.H.E.W., Division of Air Pollution, Cincinnati, Ohio, 1966.

9/ Public Health Service, Compilation of Air Pollutant Emission Factors. Publication No. 999-AP-42, Environmental Health Series, U.S.D.H.E.W., NAPCA, Durham, North Carolina.

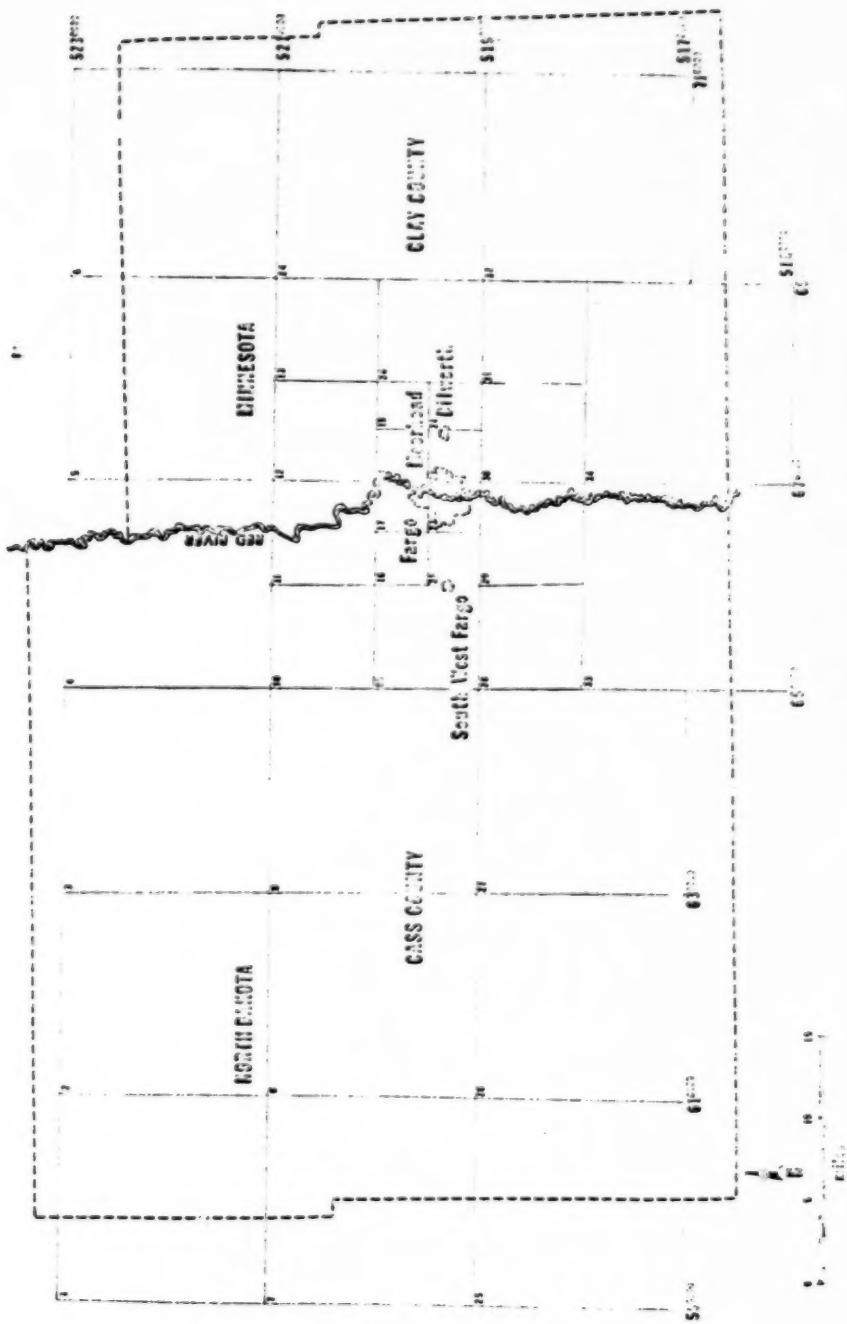

FIGURE 6 - Grid Coordinate System for the Fargo-Moorhead Study Area

Table VI

Air Pollutant Emissions From All Sources in the Fargo-Moorhead Study Area, 1968

(Annual Average Tons Per Day)

Grid	Land Area (Sq. Mi.)	Sulfur Oxides	Partic-ulates	Carbon Monoxide
1	154.4	0.0	1.4	0.8
2	154.4	0.1	1.3	1.8
3	154.4	0.1	4.4	2.0
4	154.4	0.1	2.2	2.0
5	154.4	0.1	1.9	1.3
6	154.4	0.1	1.9	1.7
7	154.4	0.0	0.7	1.6
8	154.4	0.1	3.4	2.8
9	154.4	0.1	4.3	2.9
10	38.6	0.0	0.8	0.9
11	38.6	0.0	0.3	1.3
12	38.6	0.1	1.1	1.5
13	38.6	0.0	0.4	0.5
14	154.4	0.2	3.2	3.5
15	38.6	0.0	3.6	1.1
16	9.6	0.0	0.1	0.6
17	9.6	4.2	5.4	19.4
18	9.6	4.3	18.8	3.2
19	9.6	0.0	0.0	0.4
20	38.6	0.1	1.0	0.7
21	9.6	0.1	1.1	1.0
22	9.6	6.8	13.6	42.8
23	9.6	1.1	4.2	26.5
24	9.6	0.1	0.1	0.4
25	154.4	0.0	0.0	0.7
26	154.4	0.1	4.0	1.9
27	154.4	0.1	1.6	1.7
28	38.6	0.0	0.0	0.8
29	38.6	0.0	3.9	1.3
30	38.6	0.1	0.4	1.6
31	38.6	0.0	0.0	1.3
32	154.4	0.2	1.7	2.3
33	154.4	0.1	1.6	2.0
34	154.4	0.1	1.7	3.3

Five pollutants were inventoried: sulfur oxides, particulates, carbon monoxide, hydrocarbons, and nitrogen oxides. The emissions were estimated for five categories of source: transportation, stationary fuel consumption, solid waste disposal, industrial processes, and evaporation losses.

Summary of Results

From data obtained by the inventory, the following summary was derived:

Sulfur Oxides — The largest portion of the sulfur oxides emitted in the Study Area came from three individual sources. The largest source, a steam-electric utility in Cass County, emitted approximately 28 percent of the total sulfur oxides. Two other large sources, a sugar beet plant in Clay County and a university in Cass County, emitted over 42 percent of the total sulfur oxides. This can easily be explained since these three sources consumed over 97 percent of the total coal utilized by all sources. The remaining individual sources together with the area sources emitted 30 percent of the 6,800 tons of sulfur oxides.

Particulates	Nearly fifty feed and grain elevators in the Study Area contributed about 53 percent of total particulates emitted. The three large coal users contributed an additional 39 percent. The remaining individual sources together with the area sources emitted only 8 percent of the 32,200 tons of particulates.
Carbon Monoxide	Motor vehicles contributed 86 percent of the carbon monoxide emitted annually. Other sources included (1) solid waste disposal and (2) railroads and aircraft which accounted for 3.6 and 7.8 percent, respectively, of total emissions.
Hydrocarbons	The three largest sources of the 11,100 tons of hydrocarbons were motor vehicles, automobile evaporation losses and the storage and handling of gasoline. They contributed 31 percent, 20 percent, and 31 percent, respectively, of total hydrocarbon emissions. The remaining 18 percent was divided among industrial process sources, solid waste disposal, aircraft, and evaporative losses from dry cleaning plants.
Nitrogen Oxides	The two largest sources of nitrogen oxides were stationary fuel combustion and transportation sources, accounting for 49 percent and 48 percent respectively. The other 3 percent was emitted from solid waste disposal sites.

Table VII summarizes the estimated quantities of pollutants by source. Emissions by county and source are shown in Table VIII, and the percentage contribution by county are shown in Table IX. Figure 7 indicates the location on the grid zone map of the inventoried point sources, and both point and area source estimates were combined and attributed to grid zones to produce density maps (Figures 8a, 8b, 8c, 8d and 8e).

AIR QUALITY ANALYSIS

The boundaries of an air quality control region should be drawn to include both pollution sources and people and property affected. The inventory identified pollution sources in the study area, but does not provide information about people and property affected. The atmospheric distribution of pollutants from the sources should be determined in order to satisfy this requirement.

The best way to do this is to review air quality sampling data over time at sufficient points to provide an adequate pattern from measured data. Data supplied by the North Dakota State Department of Health has been useful in this analysis, but is limited to sampling from a station at Fargo.

In order to extend estimates of distribution over the study area, a meteorological diffusion model has been used to describe theoretical concentrations of pollutants in the ambient air. The model is based on mathematical treatment of pollutant emissions and meteorological factors such as wind speed and direction and mixing depths.

Table VII

Summary of Air Pollutant Emissions in the Metropolitan Fargo-Moorhead Study Area, 1968

(tons per year)

Source	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Transportation	(290)	(620)	(47,110)	(4,410)	(3,200)
Road Vehicles	230	400	43,180	3,450	2,670
Other Vehicles	60	220	3,930	960	530
Fuel Combustion	(6,470)	(13,450)	(1,000)	(280)	(3,190)
Industrial	1,620	6,430	150	50	1,210
Power Generation	1,900	4,480	20	10	1,000
Residential	800	150	30	50	290
Commercial and Institutional	2,150	2,390	800	170	690
Refuse Disposal	(40)	(360)	(1,790)	(450)	(200)
Incineration	30	130	550	10	40
Open Burning	10	230	1,240	440	160
Industrial Process Losses	0	18,800	360	0	0
Evaporation Losses	--	--	--	5,950	--
Total Emissions	6,800	33,200	50,300	11,100	6,600

Table VIII

Air Pollutant Emissions in the Metropolitan Fargo-Moorhead Study Area by Emissions Sources and by County, 1968 (tons per year)

	County	Industrial	Institutional	Residential	Power Plants	Total Fuel Combustion	Industrial Process Losses	Transportation	Refuse Disposal	Grand Total [a]
Particulates	Cass (N.D.)	10	1,990	90	4,490	6,580	12,160	410	190	19,340
	Clay (Minn.)	6,410	400	50	0	6,860	6,640	210	170	13,880
Sulfur Oxides	Cass (N.D.)	30	1,670	500	1,900	4,100	0	180	20	4,300
	Clay (Minn.)	1,590	480	290	0	2,360	0	110	20	2,390
Carbon Monoxide	Cass (N.D.)	n [b]	670	20	30	720	360	29,710	920	31,710
	Clay (Minn.)	150	130	10	0	290	0	17,400	870	18,560

[a] Totals have been rounded

[b] Negligible

Table IX

Percentage Contribution of Each County to Total Air Pollutant Emissions

County	Sulfur Oxides	Partic-ulates	Carbon Monoxide	Hydro-carbons	Nitrogen Oxides
Cass	63	58	63	65	58
Clay	37	42	37	35	42

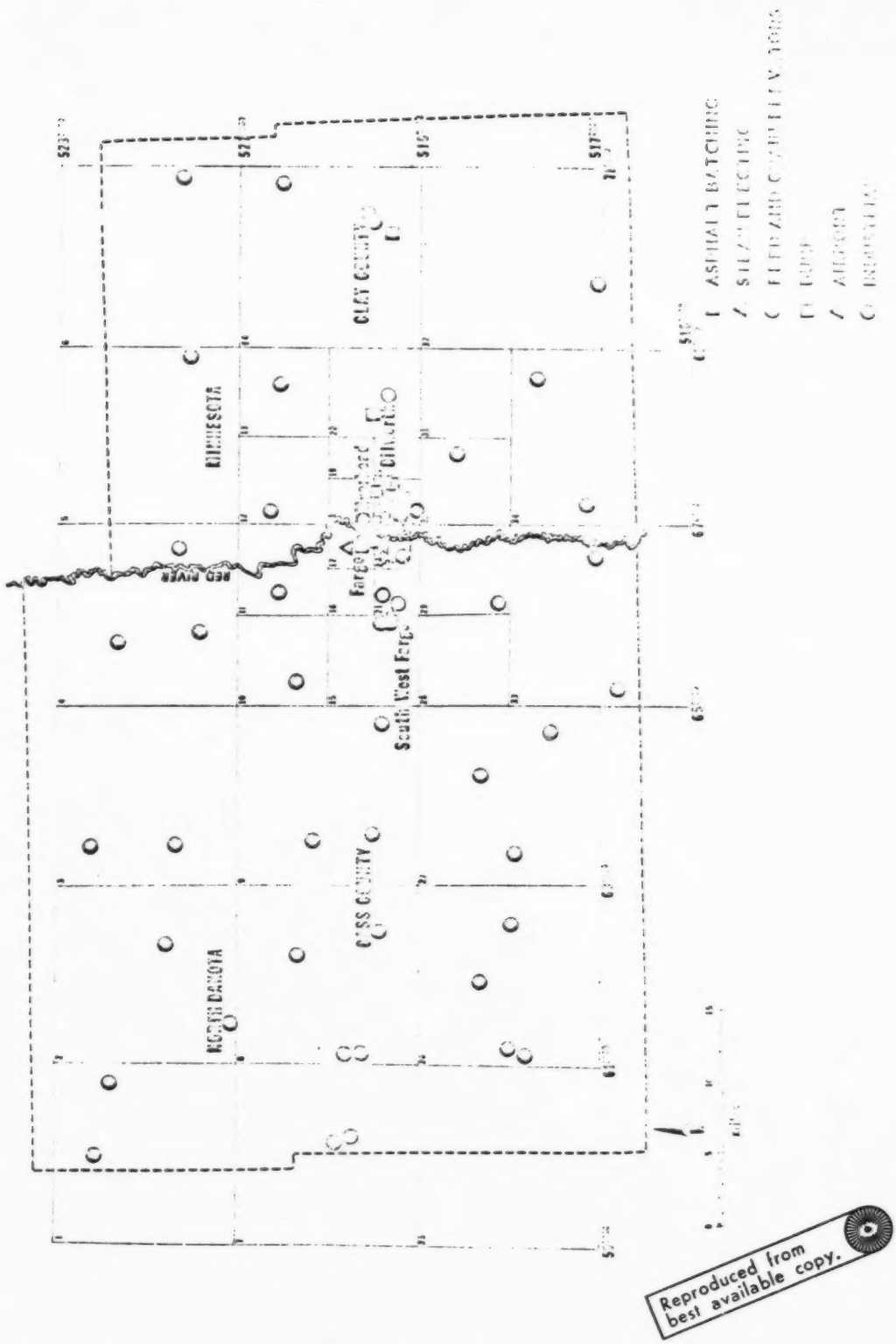

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FIGURE 7 - Point Source Locations for the Fargo-Moorhead Study Area

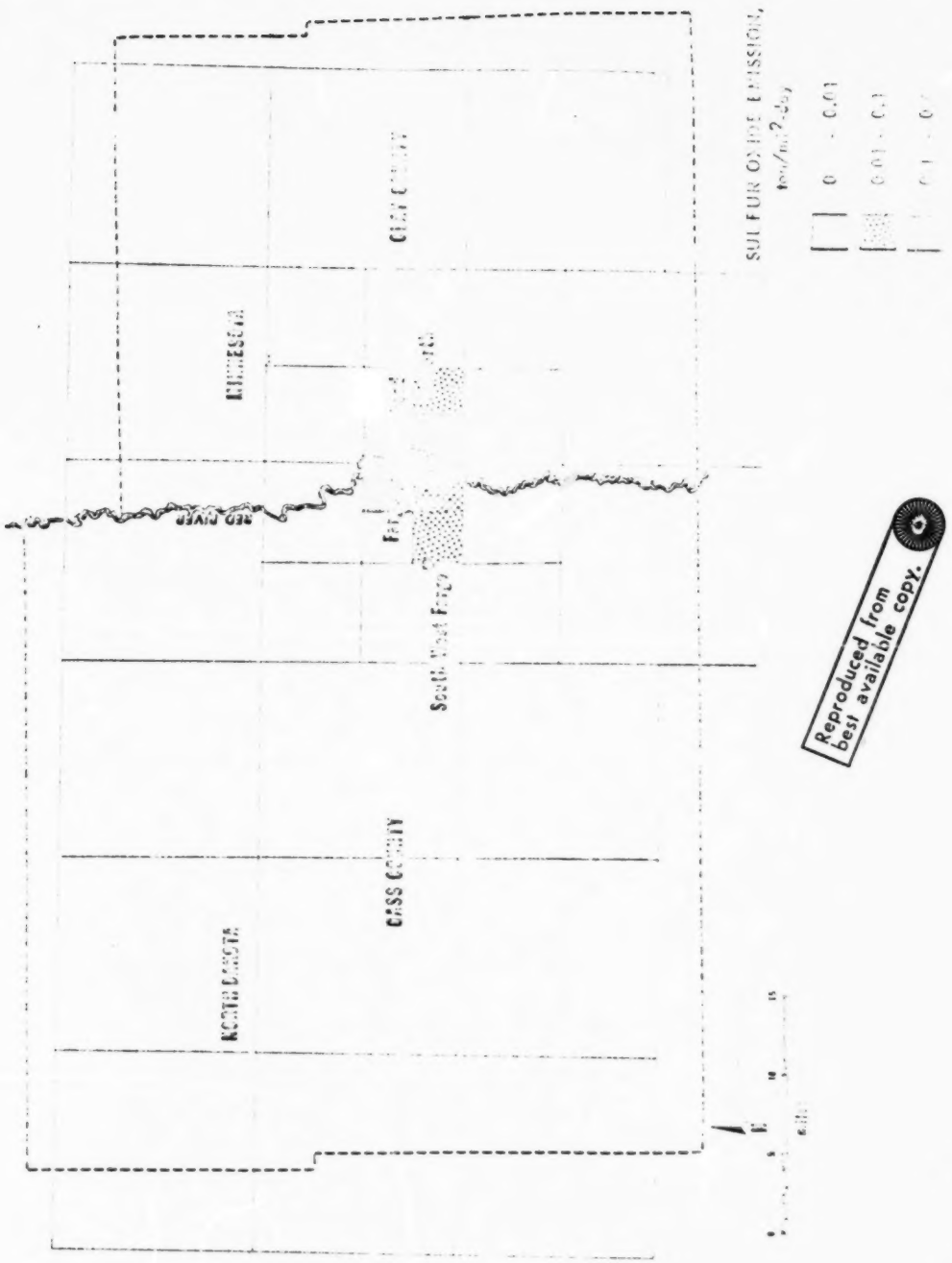

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FIGURE 8a - Sulfur Oxide Emission Density From All Sources For the Fargo-Moorhead Study Area

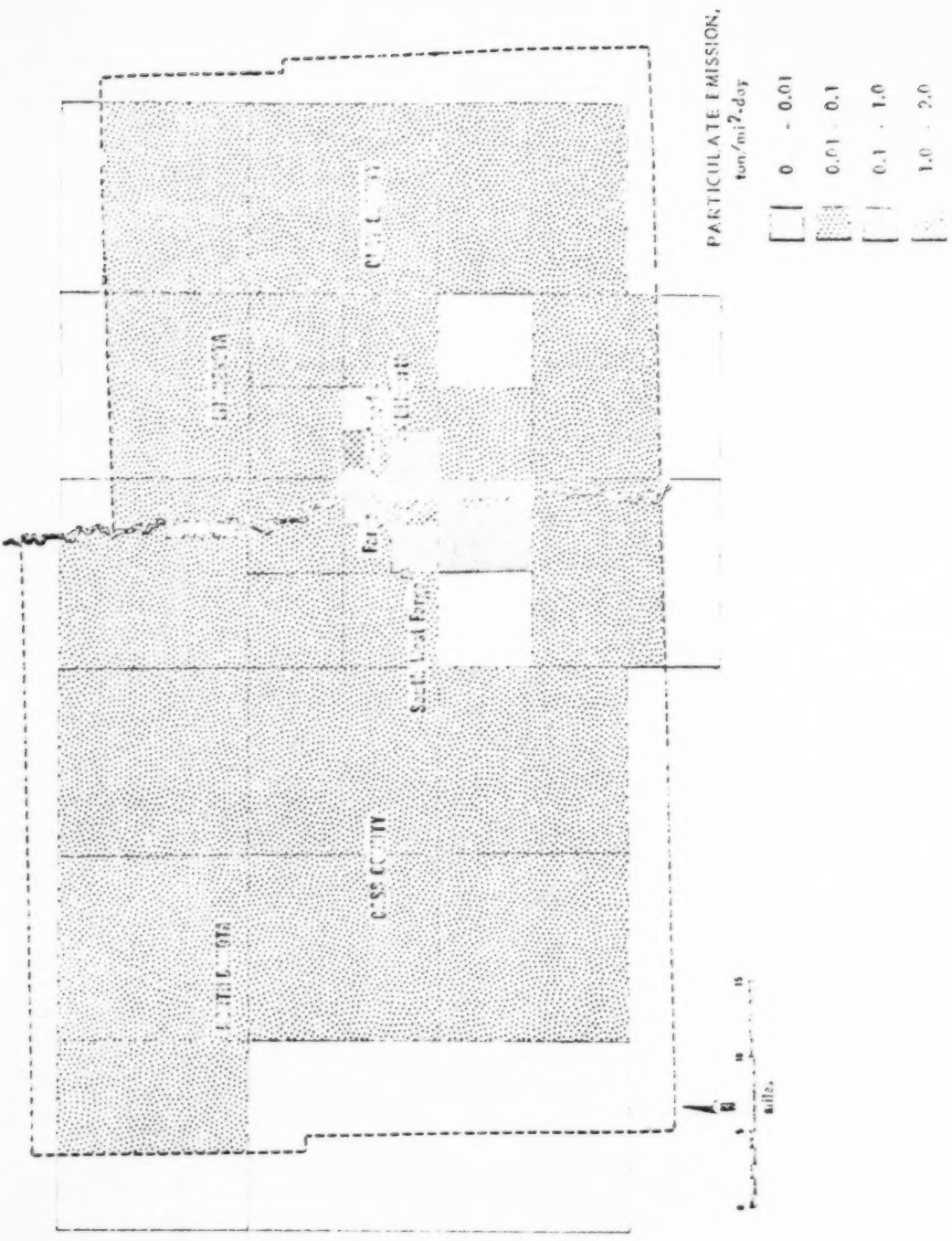

FIGURE 8b - Particulate Emission Density From All Sources For the Fargo-Moorhead Study Area

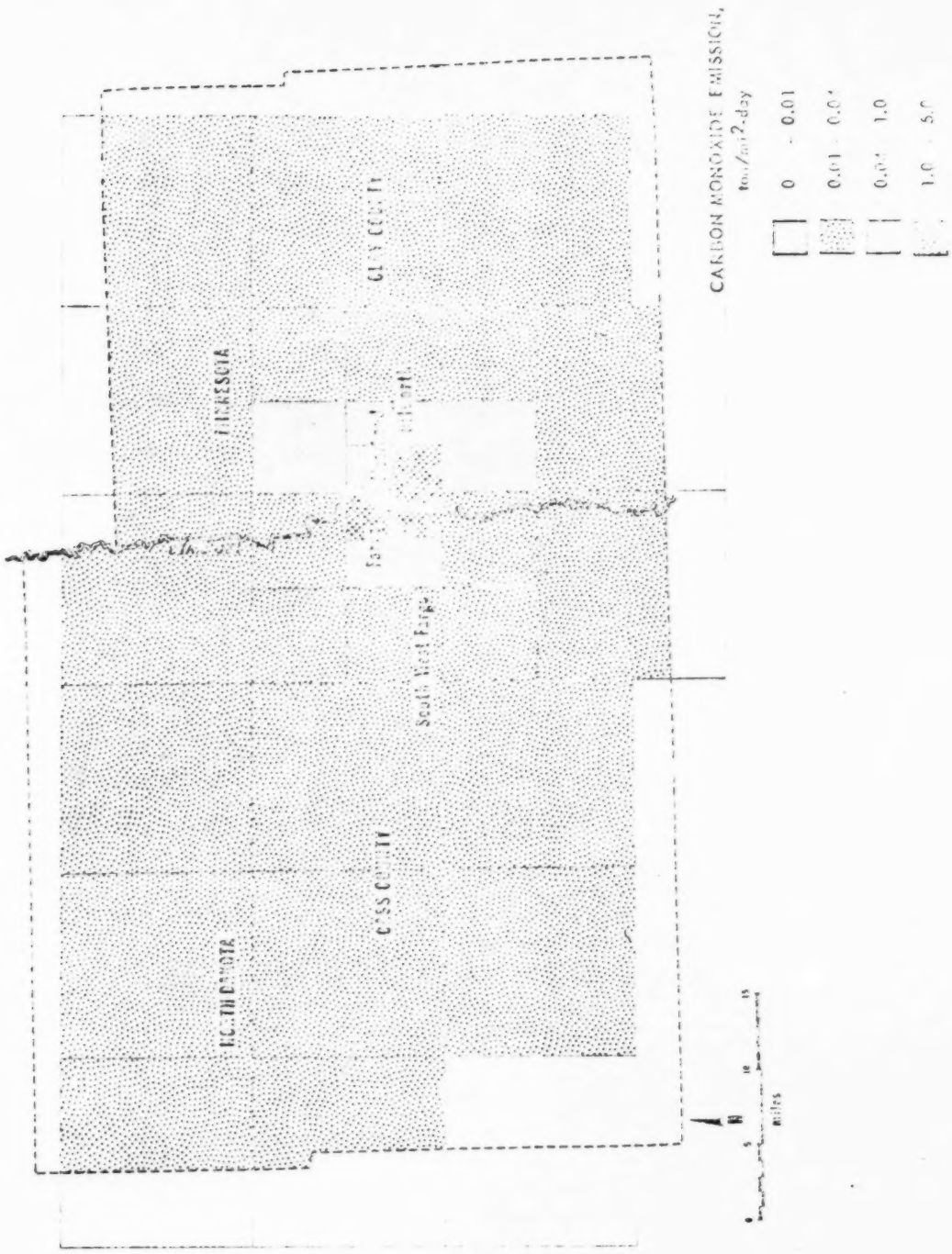

FIGURE 8c - Carbon Monoxide Emission Density From All Sources For the Fargo-Moorhead Study Area

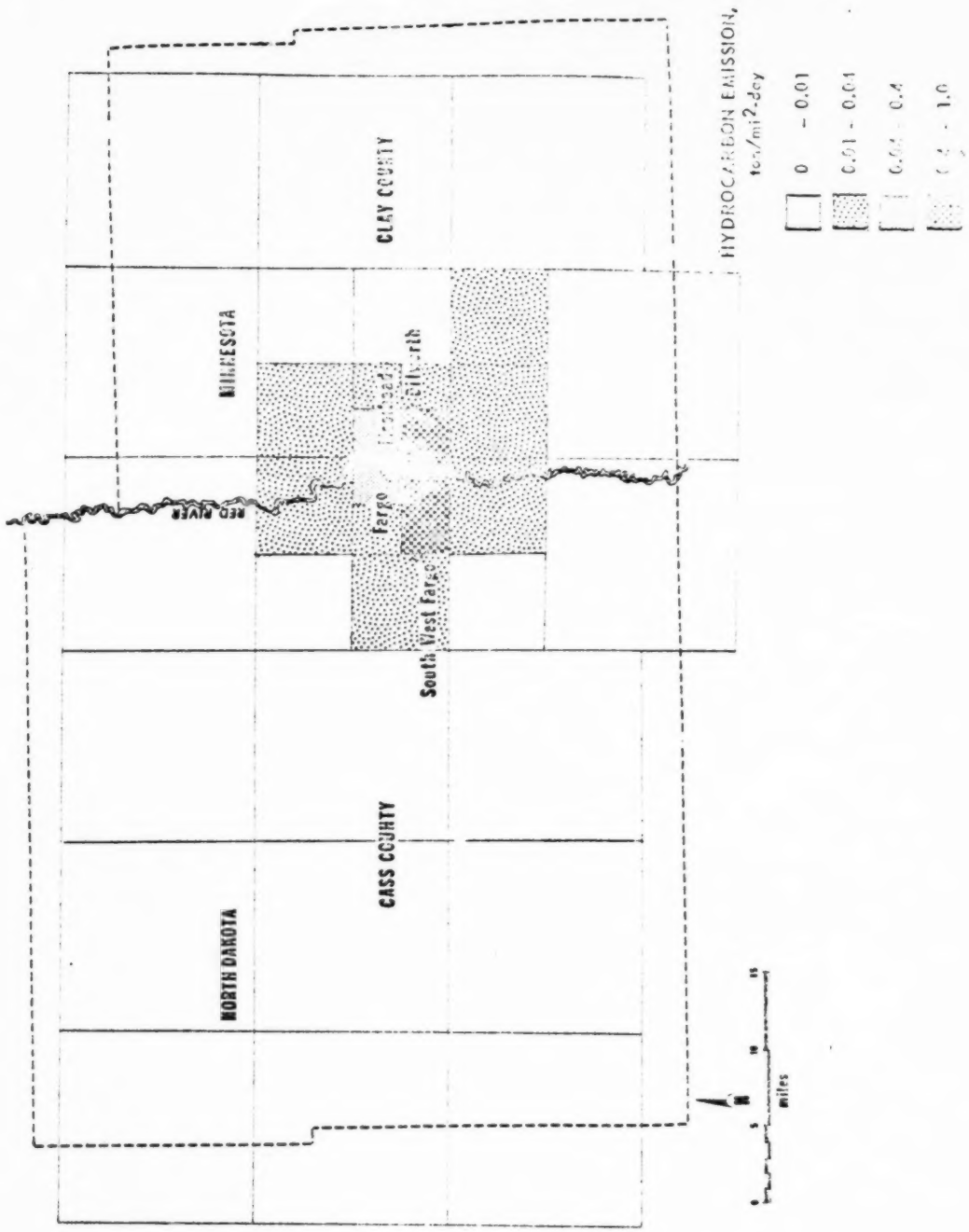

FIGURE 8d - Hydrocarbon Emission Density From All Sources For the Fargo-Moorhead Study Area

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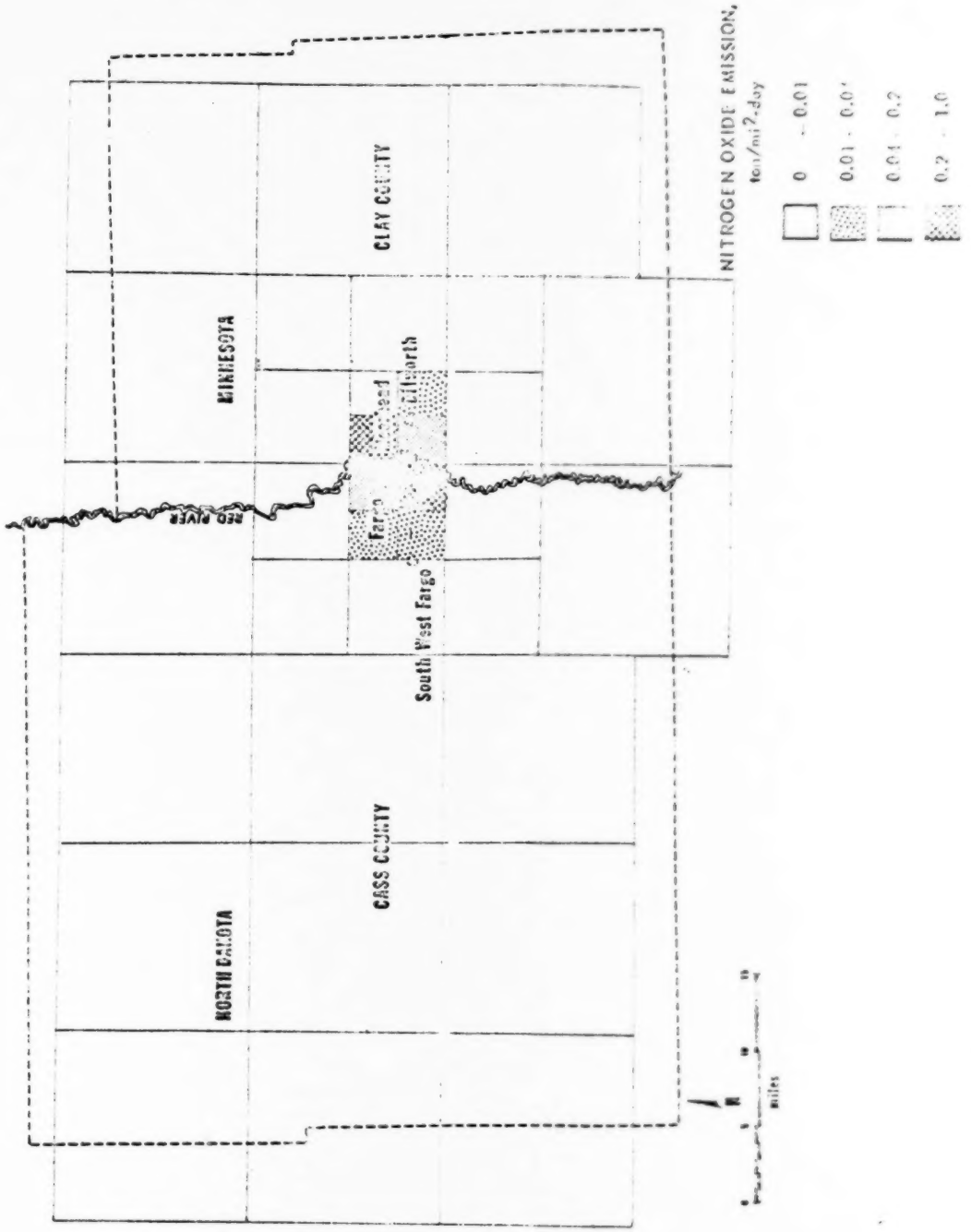

FIGURE 8e - Nitrogen Oxide Emission Density From All Sources For the Fargo-Moorhead Study Area

Although the model has inherent limitations, it is useful in mapping theoretical long-term average pollutant dispersion patterns.

Meteorology

The Fargo-Moorhead area is in the Red River Valley of the North, part of the Hudson Bay drainage area. Its terrain is relatively flat and open with northerly winds blowing up the valley occasionally causing low cloudiness and fog. Summers are generally cool with very few days of hot and humid weather. Winter months are cold and dry with maximum temperatures rising above freezing only about six days per month and nighttime lows below zero about half the time. With the flat terrain, surface friction has little effect on the wind in the area. Winds, averaging 10-15 mph, provide good ventilation, although mixing depths tend to be relatively low (Figure 9 and Table X):

Table X

Air Mixing Depths

(meters)

	Winter	Summer	Annual
Morning	260	300	310
Afternoon	520	1800	1265
Average	390	1050	790

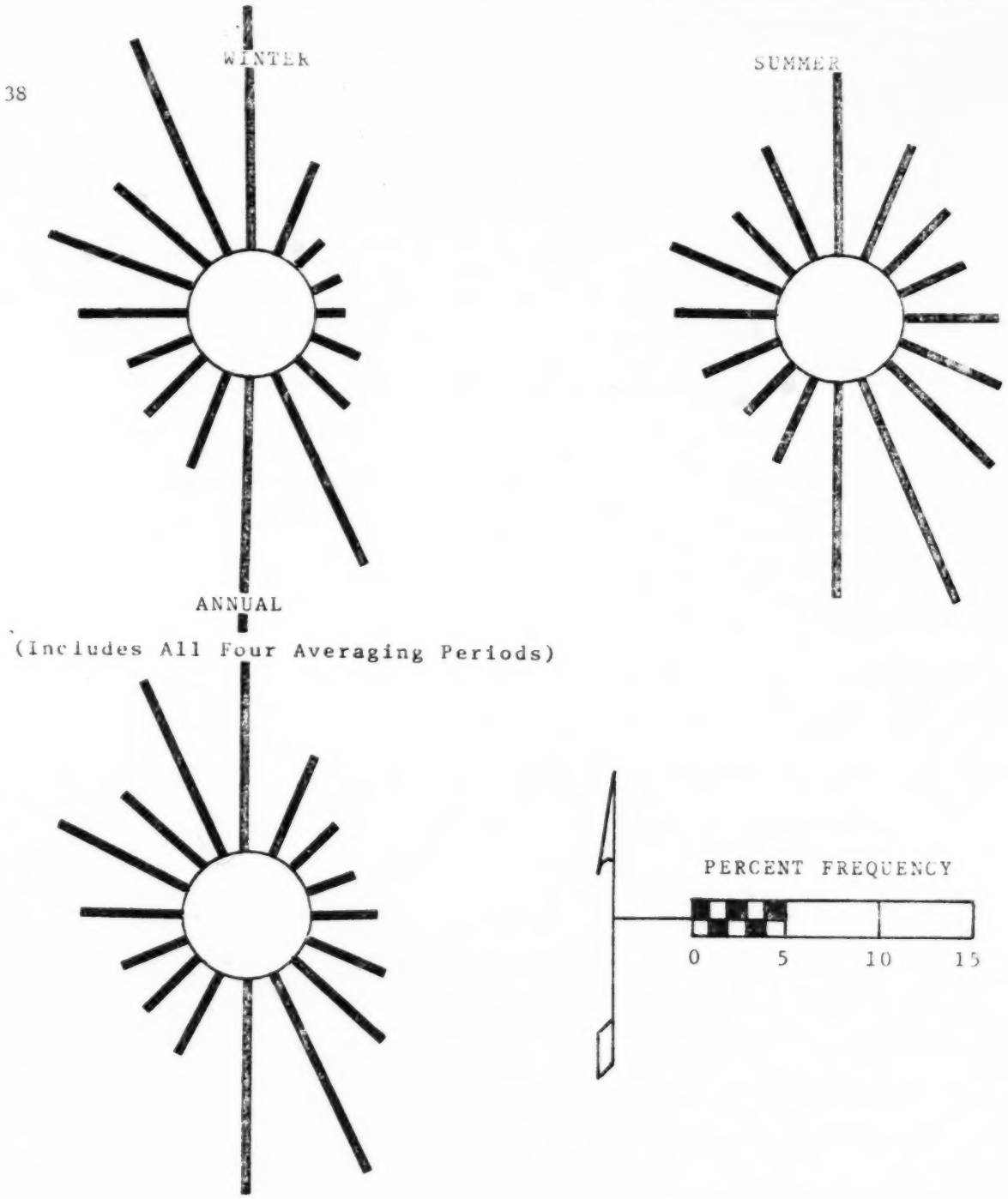

FIGURE 9- Wind Direction Percent Frequency of Occurrence for Various Averaging Times

The low mixing depths of winter months, coupled with increased fuel consumption for both space heating and electric power generation, could be expected to create higher ground level concentrations of pollutants than might be expected by considering wind velocity alone.

Modeling Results

Contours defined by the diffusion model are shown in Figures 10a, 10b, and 10c. The theoretical dispersion is relatively well contained within the urban areas of Fargo and Moorhead. Most of the motor vehicle traffic, industrial operations and power generation activities are within this area. The many grain elevators and feed mills within the study area, while they may create particulate problems within a small area around them, do not contribute high enough levels over large areas to influence the diffusion model. Although the study area imports much of its eletric power, the two existing plants and the proposed Moorhead plant, all lignite burning, contribute to the dispersion characteristics shown by the model.

Air Sampling Data

Data obtained from the NASN station at Fargo with respect to suspended particulates are not inconsistent with the inventory or the diffusion model (Table XI):

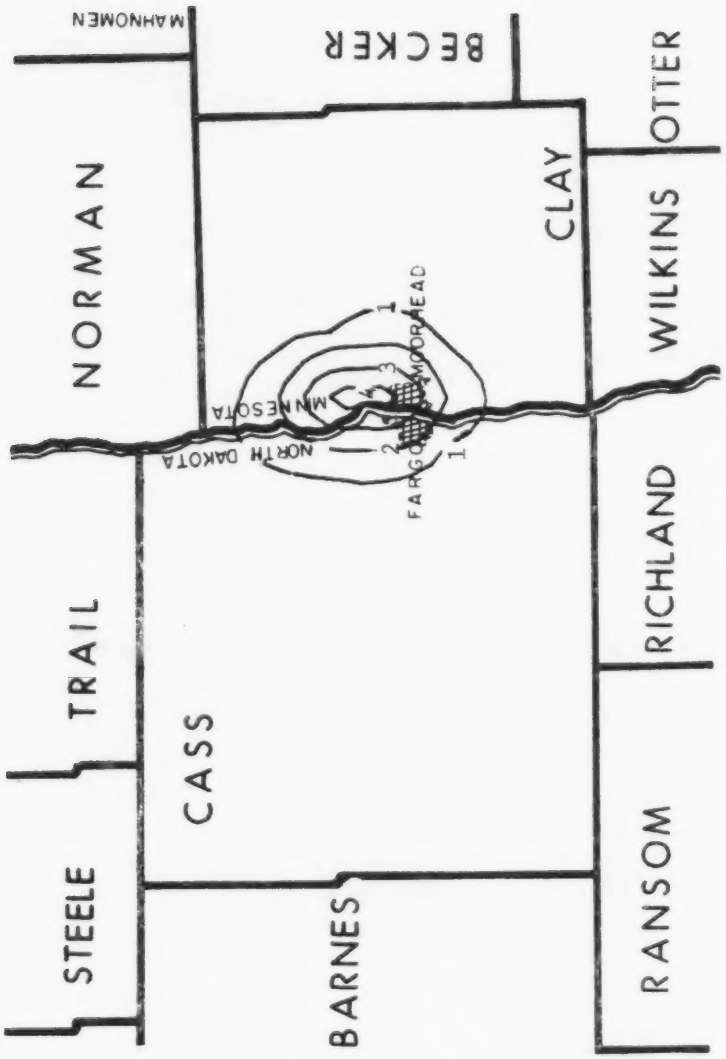

FIGURE 10a - Relative Annual Concentrations of Sulfur Oxides

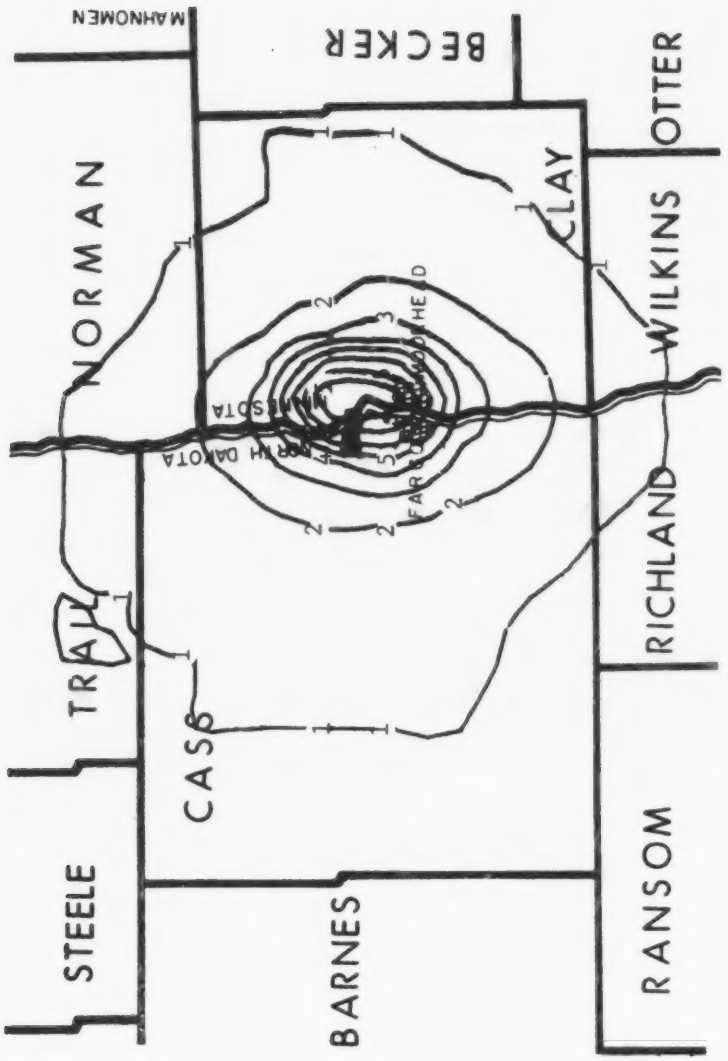

FIGURE 10b - Relative Annual Concentrations of Particulates

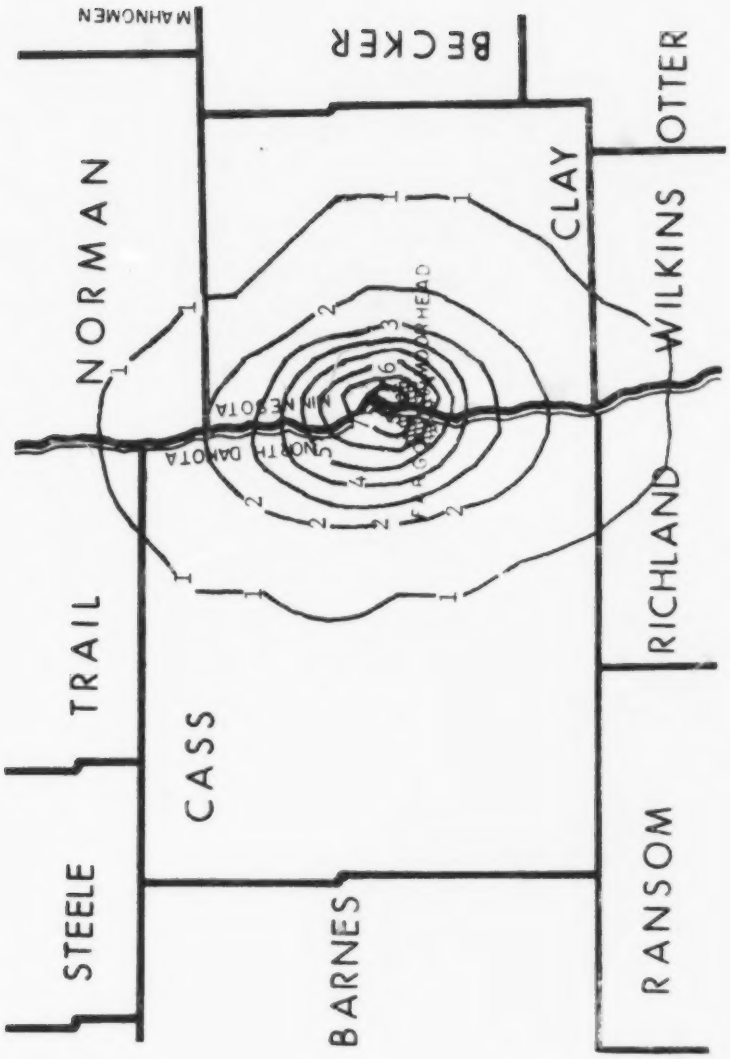

FIGURE 10c - Relative Annual Concentrations of Carbon Monoxide

Table XI

Yearly Average Values, Suspended Particulates
Fargo, North Dakota

	(micrograms/cubic meter)
1964	94
1965	84
1966	64
1967	63
1968	73
All years	76

Spot samples from the station range from a maximum of 387 $\mu g/m^3$ (2/16/68) to a minimum of 10 $\mu g/m^3$ (10/17/68)[10/].

Conclusion

Analysis of the emission inventory, the diffusion model, and air sampling data indicate that pollutant concentrations are heaviest in the immediate Fargo-Moorhead area.

10/ Communication from Dana K. Mount, North Dakota State Department of Health, to Fargo City Health Department, January, 1969.

REGIONAL GOVERNMENTAL ORGANIZATION

Regional Planning Body

The Fargo-Moorhead-Dilworth-West Fargo Metropolitan Council of Governments and Planning Commissions has comprehensive planning responsibility for Cass and Clay Counties. Established in 1967 as a planning body to conduct transportation planning as required to qualify for Federal highway funds, the COG developed areawide land use and transportation plans. On the basis of these plans, constituent governments were able to direct their own land use and transportation policies in a non-conflicting, mutually reinforcing manner. More recently, the COG has directed its attention to health, water, and sewer planning.

Metropolitan Clearinghouse

In accordance with the Intergovernmental Cooperation Act of 1968, the Fargo-Moorhead-Dilworth-West Fargo Metropolitan Council of Governments and Planning Commissions has been designated as a Metropolitan Clearinghouse. Through the clearinghouse, Federal development assistance is coordinated with State, regional, and local comprehensive planning. As a clearinghouse, the COG is responsible for the review of project proposals and applications for Federal assistance submitted by localities within its planning jurisdiction.

State Planning Districts

In January, 1970, the Governor of North Dakota issued an executive order dividing the State into eight regions for planning and administrative purposes. The North Dakota portion of the study area is included in a six-county planning region consisting of Cass, Steele, Trail, Ransom, Sargent, and Richland.

In Minnesota, statewide discussions regarding state planning district boundaries began in 1969. On June 12, 1970, the Governor officially approved the establishment of eleven state planning districts. Regional development commissions which will be established in the future must coincide with these district boundaries. The Minnesota portion of the Fargo-Moorhead metropolitan study area is within a nine-county planning district which includes Clay, Pope, Becker, Wilkin, Otter Tail, Traverse, Grant, Stevens, and Douglas.

Areawide Comprehensive Health Planning District

The Public Health Service provides grants to local governmental organizations for areawide comprehensive health planning. The planning areas should have a population of sufficient size so that a full range of physical, mental, and environmental health services, facilities, and manpower is or can be available within the area. This means that in some cases, rural territories may have to associate with urban areas in conducting a comprehensive health planning program.

A comprehensive health planning agency--Min-Dak--has been designated to conduct a health planning program for a sixteen-county area, including the two study area counties. Created in March, 1969, Min-Dak is now engaged in defining the area's primary health care problems and in establishing an organizational structure.

Air Pollution Control Organizations

In North Dakota, the State Department of Health has responsibility for administering and coordinating a statewide program of air pollution control. The Department is assisted by an Advisory Council of seven members which is responsible for holding public hearings regarding the adoption, amendment, or repeal of air pollution rules, regulations, and standards. The Advisory Council is composed of the state health officer, the state geologist, the state highway commissioner, and four members appointed by the Governor--a representative of county or municipal government, a representative of the solid fuels industry, a representative of the fluid gas fuels industry, and one person appointed at-large. The air pollution control budget for fiscal year 1970 was $27,160 with $15,000 in Federal funds and $12,160 in local funds. No change is anticipated in the budget for fiscal year 1971. The air pollution control staff consists of one full-time professional, some part-time professional assistance, and a part-time secretary.

The Minnesota Pollution Control Agency has responsibility for air pollution control within the State of Minnesota. The Agency consists of a Director and seven members appointed by the Governor with the advice and consent of the Senate.

The Agnecy's fiscal year 1970 budget for air pollution control activities was $219,600, with $146,400 in Federal funds and $75,200 in State funds. An increase in the budget is anticipated for fiscal year 1971, with a slight reduction in Federal funds ($133,474), but nearly a doubling of State funds ($139,939). The Agency's staff presently consists of seven full-time professionals, four part-time professionals, three full-time sub-professionals, eight part-time sub-professionals, and a full-time administrator.

PROPOSED AIR QUALITY CONTROL REGION

Subject to the scheduled Consultation, it seems appropriate to consider an interstate air quality control region in the Metropolitan Fargo-Moorhead area consisting of the following counties (Figure 11):

In North Dakota

Cass County

In Minnesota

Clay County

Discussion

An air quality control region should meet four basic criteria:

1. It should encompass most pollution sources as well as most people and property affected by the sources.
2. It should include those areas where industrial and residential growth may create significant future problems.
3. It should be consistent with unified and cooperative administration of the region's air resources.
4. It should promote enhancement and protection of the area's future environment.

The proposed Region for the Metropolitan Fargo-Moorhead interstate area would satisfy the requirements of these critiria.

The discussions in the preceding sections of technical, urban, and governmental factors relevant to a determination of the Region's boundaries lead to the following conclusions:

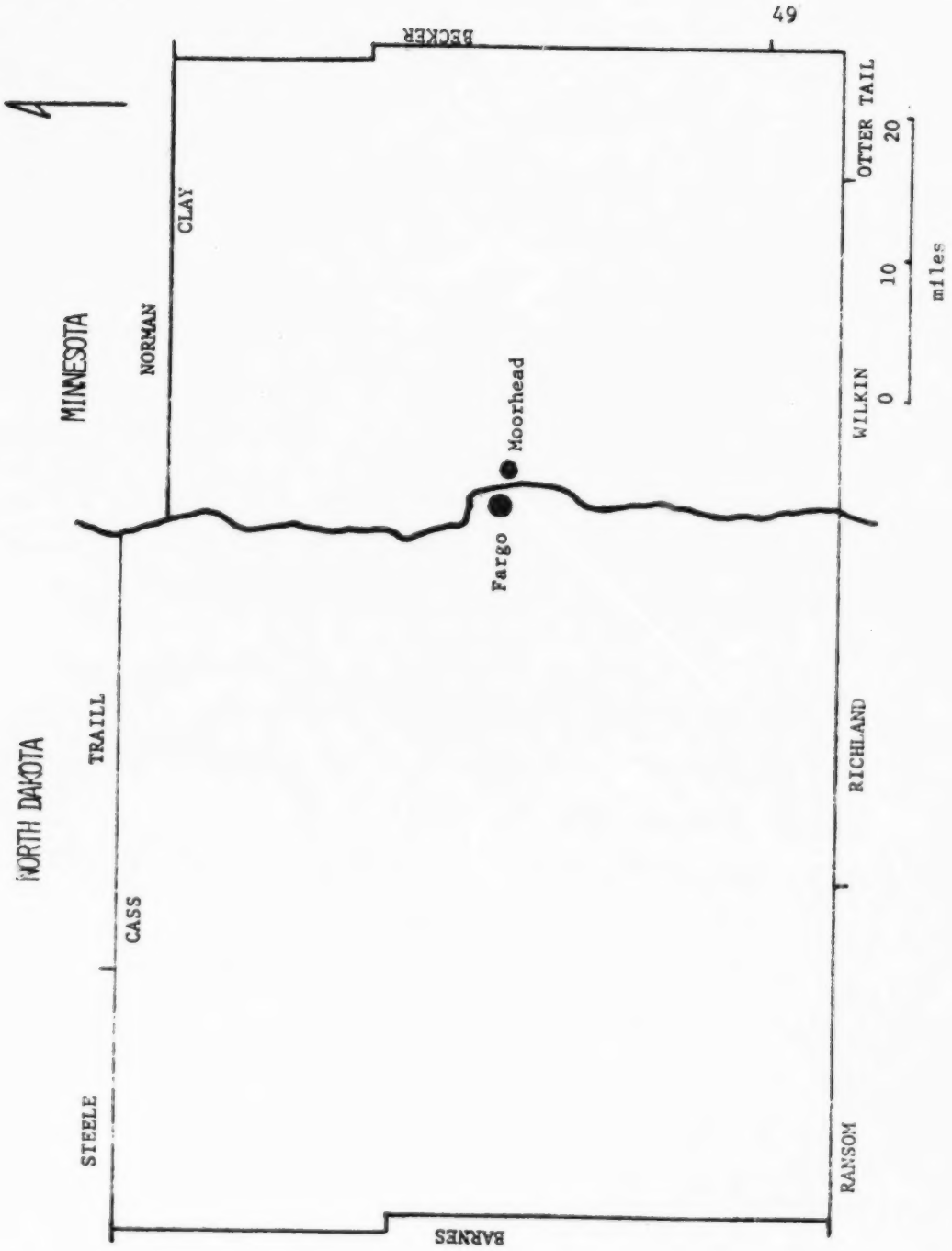

FIGURE 11 - Proposed Metropolitan Fargo-Moorhead Interstate Air Quality Control Region

1. Most of the pollution sources in the Metropolitan Fargo-Moorhead interstate area are located within the proposed Region. Sources of sulphur oxides and nitrogen oxides are closely concentrated within Fargo and Moorhead. Major sources of particulates and carbon monoxide are similarly concentrated. Minor sources of particulates pollution are widely dispersed because of the location of grain elevators and feed mills throughout the proposed Region. Motor vehicle traffic in the rural areas is a dispersed but minor source of carbon monoxide.

The effects of major pollutants are mainly contained in the heavily populated part of the proposed Region. Areas outside the proposed Region which may be affected by pollution from grain elevators and feed mills are sparsely populated.

2. The Region as proposed would provide for anticipated urban growth outward in the next decade from the present centers of Fargo, Moorhead, and West Fargo. Because these cities are clustered near the center of the proposed Region, expansion in any direction could be accommodated within the boundaries proposed. Moreover, physical expansion which is likely to take place will be modest in scale, reflecting slow population growth and a gradual increase in commercial activity. No major growth or diversification of manufacturing is expected.

Hence, the proposed Region should be adequate for presently foreseeable air quality control needs as well as for those which exist today.

3. The proposed Region would permit a unified and cooperative administration of its air resources.

The North Dakota State Department of Health has responsibility for administration of air pollution control in the State of North Dakota, and the Minnesota Pollution Control Agency has similar responsibilities for the State of Minnesota. Neither State has established or proposed programs with particular reference to the counties of the proposed Region.

The two counties of the proposed Region constitute the jurisdictional area of the Fargo-Moorhead-Dilworth-West Fargo Metropolitan Council of Governments and Planning Commissions. Since establishment of the COG in 1967, the constituent governments in the two-county area have had extensive experience in working together in land use and transportation planning. The COG is now extending its work into comprehensive health, water, and sewer planning. As the designated Metropolitan Clearinghouse under the Intergovernmental Cooperation Act of 1968, the COG reviews project proposals and applications for Federal development assistance originating in the two-county area for conformity with areawide plans.

Although Cass and Clay Counties have more recently been included as members of other, larger planning bodies, their participation in these other groups has not yet required the degree of cooperation which they have established through joint membership in the COG.